Damage From Earthquakes 'Not a Significant Risk' for San Onofre

Email Discussed at San Onofre Community Engagement Panel Meeting on May 22, 2014

From: William Parker
Date: Thursday, May 22, 2014 at 3:16 PM
To: David G. Victor
Re: Richter Scale vs. Ground Movement

David,

You asked for a few comments on the difference between the Richter scale and ground movement as measured by acceleration.

As you know, the Richter scale is a measure of the total energy released during an earthquake. But it is ground motion that determines how a structure will respond in an earthquake. The ground motion at any specific location depends on the distance from the epicenter of the earthquake and on the geological and topographical characteristics of the local and intervening rock. A reasonable measure of the ground motion is "peak acceleration" and is typically used as criteria in the design of structures.

Nuclear facilities (as well as all structures) are designed to withstand a "peak ground acceleration." Ground acceleration is typically measured as a percent of the acceleration of a freeing falling object due to gravity ($g = 9.8\ m/s^2$). Thus an acceleration of $4.9\ m/s^2$ would be written as 0.5g.

According to SCE, SONGS is designed to withstand a peak ground acceleration of at least 0.67g and the dry cask storage containers at least 1.5g.

To provide some context for these design criteria consider the earthquake off the coast of Japan on March 11, 2011. This earthquake (known as the Tohoku earthquake) measured 9.0 on the Richter scale and was the most powerful earthquake ever recorded near Japan and the fifth most powerful earthquake in the world since modern record keeping began in 1900. The reactors of Fukushima Daiichi are located approximately 99 miles from the epicenter of Tohoku earthquake and the reactors at Onagawa were closer to the epicenter at 56 miles.

The peak ground acceleration at Fukushima Daiichi during the Tohoku earthquake varied from 0.30g to 0.55g (the six reactors at Fukushima Daiichi experienced different ground accelerations), and at Onagawa the peak ground acceleration varied from approximately 0.54g to 0.61g. The peak ground acceleration was sufficient at both locations to trigger automatic shutdown of the nuclear reactors, but none of the reactors at either locations suffered significant structural damage.

Thus all the nuclear power stations in Japan during the Tohohu earthquake experienced peak ground accelerations less than the design criterion of SONGS.

The largest earthquakes in California were of Richter magnitude approximately 7.8 – 7.9 [Fort Tejon (1857), Imperial Valley (1892) and San Francisco (1906)]. The maximum credible earthquake on San Andreas is approximately 8.1 on the Richter scale as reported by some sources. The shortest distance between SONGS and the San Andreas Fault is approximately 56 miles. Roughly speaking, the "big one" on the San Andreas Fault would produce significantly less ground shaking at SONGS than that actually experienced by the Onagawa nuclear plant station in 2011. Thus the experience in Japan with the Toholu earthquake and the Onagawa nuclear power station suggests that damage from earthquakes is not a significant risk for SONGS.

SCE has also shared with me actual accelerations experienced by the reactors at SONGS during several of the recent large earthquakes in Southern California. On June 28, 1992 the Landers Earthquake (magnitude 7.3) produced a peak ground acceleration of 0.38g, and on January 17, 1994 the Northridge Earthquake (magnitude 6.7) produced a peak ground acceleration of 0.25g. Before SONGS was constructed, the Long Beach earthquake of March 10, 1933 on the Newport-Inglewood fault (magnitude 6.4) resulted in significant damage because of unfavorable geological conditions (landfill, water-soaked alluvium) and poorly constructed buildings. None of these earthquakes compare to the scale of the Tohoku earthquake.

Bill Parker*

*Dr. William Parker is a research professor of physics and astronomy at the University of California, Irvine. He has been a member of the San Onofre Community Engagement Panel since February 2014.